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DEMAND-PERFORMANCE-SUPPLY EQUILIBRIA IN CENTRALLY PLANNED ECONOMIES: A THREE-LEVEL APPROACH

by

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TABLE OF CONTENTS

Page

1. INTRODUCTION 1

2. CHARACTERISTICS OF KORNAI'S DEMAND-DRIVEN SHORTAGE ECONOMY 1

   A. Main characteristics 2
   B. Some objections. 5

3. EQUILIBRIUM THROUGH THE EXPLICIT MODELING OF PERFORMANCE 6

   A. Demand, performance and supply procedures. 6
   B. Equilibria and other characteristics 10
   C. Some microeconomic foundations 12

4. CONCLUSION 17

5. REFERENCES 19

List of figures:

Figure 1: Mechanism generating shortage in the short term 4

Figure 2: Shortage and market in the short term 4

Figure 3: Market analysis: a three-level approach 10

Figure 4: Two price-wait time Demand-Supply equilibria. 15

Figure 5: The effect of price regulation on quantity traded and wait time 16

ABSTRACT

We adapt and develop for the analysis of Centrally Planned Economies a conceptual framework originally designed for the analysis of transportation systems. This framework adds an explicit **performance** level between the **demand** and **supply** levels of analysis. This three-level approach, formulated very generally here to distinguish it from particular formulations and allow them as nested special cases, makes possible the definition of multiple equilibria defined on quantities, prices and service levels. The specifics of how queues (and black and shadow markets) can yield an **extended equilibrium** are outlined and the implications of the three-level approach for econometric model estimation alluded to. We contrast our approach mainly to that of Kornai.

Key words : Centrally Planned Economies; extended equilibrium; queues; Kornai.

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RÉSUMÉ

Nous adoptons et développons à des fins d'analyse des économies centralisées un cadre conceptuel destiné à l'origine à l'analyse des systèmes de transport. Ce cadre à trois nieaux ajoute à l'étude de la **demande** et de l'**offre** une formalisation explicite de la **performance** du système qui rend possible, à l'intérieur d'une formulation très générale compatible avec de nombreux cas particuliers, la spécification de plusieurs équilibres multiples définis sur les quantités, les prix et les niveaux de service. Nous explorons, en particulier, la façon dont les files d'attente (et, par extension, les marchés noirs et au noir) rétablissent un **équilibre élargi** et esquissons certains avantages économétriques d'une approche à trois niveaux. Nous soulignons certaines différences significatives entre l'approche de Kornai et la nôtre.

Mots-clés : économies centralisées; équilibre élargi; files d'attente; Kornai.

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ZUSAMMENFASSUNG

Für die Analyze der Planwirtschaft wenden wir ein drei-stufiges Konzept an, das ursprünglich im verkehrswissenschaftlichen Bereich entwickelt wurde. Im Rahmen dieses Konceptes wird die **Leistungsfähig** kein einer Unternehmens neben der **Nachfrage** und das **Angebot** explizit berüchsichtigt. Dieser drei-Stufen Ansatz wird so allgemein formuliert, das er **mehrfache Gleichgewichte** über Preise, Mengen und serviceniveaus zu definiren erlaubt. Wir erklären, wie die Warteschlangen (sowie schwarze und graue Märkte) zu einem erweiterten Gleichgelwicht führen können. Folgen des vorgestellten Preis-Serviceniveau Ausatzls werden für die Schätzung ökonometrizcher Modelle gedeutet. Unsere Referenzbasis bildet das Model von Kornai.

Stichworte : Planwirtschaft; mehrfache Gleichgewichte; Warteschlangen; Kornai.

1. INTRODUCTION

The aim of this paper is to analyse certain aspects of the behavior of Centrally Planned Economies (CPEs) using, as an alternative to Kornai's recent approach, a conceptual framework originally formulated for the analysis of transportation systems. Key features of this framework, which is primarily of a partial equilibrium macroeconomic inspiration, include the explicit modeling of a market **performance** level - in addition to the usual **demand** and **supply** levels - and the use of mappings to contain as special cases many actual or potential specifications of particular systems of interest.

A property of the conceptual framework, as applied in particular to CPEs, but also to many regulated services of predominantly free market economies, is to emphasize the equilibrating function of time prices (queues) and of black market money prices. The explicit modeling of system performance in a three-level approach resets apparently non-Walrasian disequilibria into an "augmented" equilibrium structure.

Although this structure has implications for the proper specification of demand and supply equations and permits the use of standard econometric techniques, such issues will be addressed only marginally here: we will concentrate on the concise and simple exposition of the nature and properties of our three levels. But before, we need to summarize rapidly the crucial characteristics of Kornai's seminal formulation of a demand-driven shortage economy.

2. CHARACTERISTICS OF KORNAI'S DEMAND-DRIVEN SHORTAGE ECONOMY

Since the late Seventies, a new approach to the explanation of the functioning of the CPEs has been developed in Hungary by Kornai and his collaborators (the most complete statements of the new approach are in Kornai, 1980 and 1982). One of the present authors has extended Kornai's model to include explicitly factors concerning political decision-making

mechanisms in the CPEs and the role of expectations in understanding the behaviour of economic actors in such systems (see Kowalski, 1983, 1986a,b; Blum and Kowalski, 1986).

A. Main characteristics

Here we only very briefly present the major characteristics of the approach and refer the reader to the original papers for an extensive presentation. We note the following properties of the approach:

(a) It is positive and not normative. It purports to show how the CPEs actually function and not how they should function.

(b) A CPE is a shortage economy: widespread chronic shortages occur both in consumer markets and in intermediate goods markets: they are a normal phenomenon influencing the long-term and short-term behaviour of firms and consumers.

(c) Firms face soft budget constraints, i.e. can spend more money than they earn or get in repayable credits. This, together with their experience of shortages and their expansion drive, caused by the wish to overfull-fill plans in order to earn good marks from superiors, leads the firms to hoarding and siphoning out of all possible inputs from the markets (see Figures 1 and 2 obtained from Kowalski, 1983) and thus leads to shortages.

(d) Money and prices do not play a decisive role in the decision-making of firms. This is because of the softness of budget constraints.

(e) Soft budget constraints are accompanied by "voluntaristic", lawless, unplanned decision-making. This stems from the political system, which in fact removes top decision-makers from legal control. "Centrally Planned Economies" are to a great extent really very unplanned systems (see Kowalski, 1983). Lawlessness, in the sense of disregard for legal norms (like plans) by certain actors in the economy, is a characteristic feature of CPEs.

(f) "Normal" values of some variables play a key role in the functioning of the economy. The word "normal" is used to denote levels of variables that at a certain point of time, in a given place (a country, a region, etc.) are considered by people to be normal (for example a three-year wait for a car, three months for the execution of a purchase order for inputs, three-hour queues to get bread and so on). When the variables remain at those normal levels, the economic system **apparently** remains in a non-Walrasian equilibrium, with socially accepted levels of shortages, investment, production, consumption and growth. Deviations from normal levels act as signals and activate various adjustment mechanisms (see Kowalski, 1986a).

(g) Economic actors in the CPEs form expectations and behave in a rational manner, taking into account all relevant available information about the functioning of the system. The actors facing soft budget constraints will limit their acquisition of information less because of its costs than because of efforts (time, etc.) required to obtain the information. Expectations and information gathering occur with respect to the general shortage level and shortages on specific partial markets (see Kowalski, 1986b).

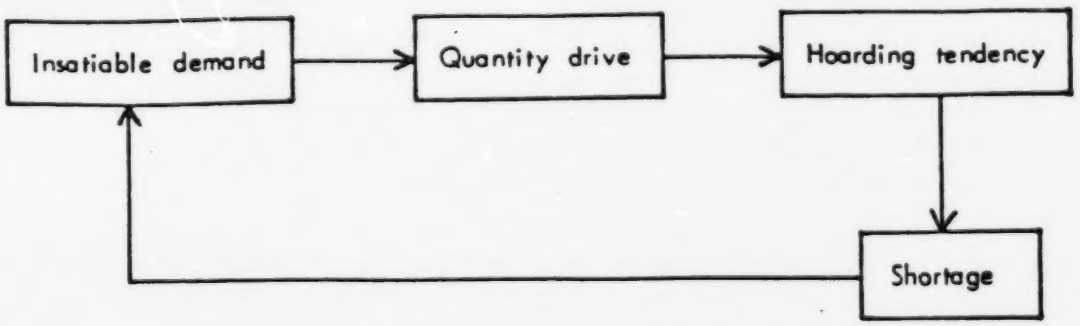

Figure 1: Mechanism generating shortage in the long run

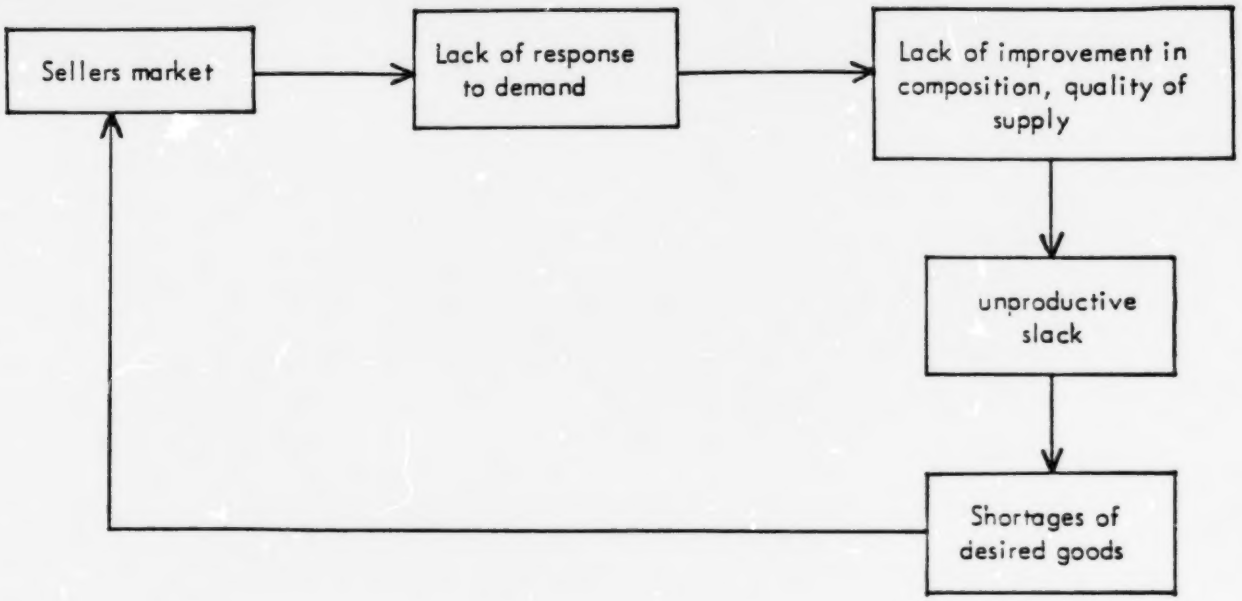
Sellers market
Lack of response to demand
Lack of improvement in composition, quality of supply
unproductive slack
Shortages of desired goods

Figure 2: Shortage and market in the short term

B. Some objections

In Kornai's model, shortages are in essence explained by "insatiable" demand generated by the softness of budget constraints. In other words, the emphasis lies on the demand side: it is through the demand side that the supply side is affected as insatiable demand leads to hoarding, bottlenecks, forced substitution and a very high degree of utilization of existing production capacities.

In a recent contribution, Simon (1984) has constructed a model in which he demonstrates that, even with budget constraints that are not infinitely soft, and consequently with price elasticities of demand different from zero (in contrast with the zero elasticities implicit in Kornai's model), the rational behavior of firms in the CPEs may still lead to shortages, and those be consistent with underutilized capacities. The reason for this is that the firms, facing prices that are to a large extent administered, do not find it worthwhile to make more effort to increase supply levels (called by Simon the "standard supply").

Simon's paper draws attention to the role of the supply side in the CPEs. The point of his approach is that the CPEs can be only understood as an interplay of demand and supply behaviour of the actors in the system. In his view, the "standard supply" - a notion linked to, but distinct from, our notion of performance - is determined not only by the physical production capacities but also by the willingness of producers to produce at certain "standard" rates. His emphasis on the explicit modeling of supplier behaviour is useful, but his formulation does not model the performance of the system proper, as a functionally separate level of modeling. His model, however, makes progress towards understanding key properties of Kornai's model such as the level of normal shortage used, but not explained by Kornai[1].

Gomulka (1986) extends Kornai's framework by distinguishing between **budget softness** and **budget flexibility.** He argues that the latter concept, which expresses the changes in firms' budgets related to changes in prices of firms' inputs and outputs, is more relevant in explaining economic behaviour in CPEs. He disregards however the impact of the budget's flexibility on shortages and firms' performance.

3. EQUILIBRIUM THROUGH THE EXPLICIT MODELING OF PERFORMANCE

Some of the "objections" to Kornai's presentation, such as Simon's can be understood as attempts to make more explicit the structural distinction between the demand and supply sides that should **explain** the "normal level of shortage". Our analysis will provide such an explanation by adding explicit performance level "between" the demand and supply sides and by distinguishing clearly, on the supply side itself, between

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[1] Kornai (Op. cit, 1982) defines and uses a shortage index both in an aggregate demand and in a "production function" equation. Joining these functions defines a Marshallian cross where the shortage index replaces price: it "is a non-price signal which provides a positive signal to production and a negative one to purchases" (p. 33). But "it is not the task of our model to explain why Z* is the normal shortage and why it is not more or less" (p. 21).

supply behaviour proper and production technology, both useful in understanding Kornai's hypothesis that "in the shortage economy the producer-seller is rather rigid... If not especially sensitive to signals from the buyer, supply is not completely rigid, either" (Kornai, 1980, p. 122). We will use a partial equilibrium framework applicable to either final or intermediate goods markets. Unless noted and stated otherwise, all of the letters used in specifying the procedures may be read as vectors but we leave the dimensions purposefully vague in order not to detract from the important points of exposition.

A. Demand, performance and supply procedures

i) **The Demand Procedure Dem**

For any market[1], final or intermediate, the first level of interest is that of **demand.** Market demand D is an outcome of, or derived from, economic activity A, the socio-economic characteristics of consumers and their budget, both denoted Y, the levels of service C and the out-of-pocket unit expenditures P. By using the notation $\doteq$ to denote a **procedure,** we have

$$D \doteq \text{Dem}\ (P, C, Y, A)\ . \qquad (1)$$

Here, as in the other levels formulated below, the notion of **procedure,** or mapping, is used to denote one or more models and their algorithmic output. It is convenient to abstract from potential specific models of the demand for particular commodities and to subsume eventually rich detailed specifications under this label. Of course, it may ease the reader's task to think of a favorite demand **function** as a special case.

In the case of a truly final good, the activity variables A are absent; in the case of intermediate goods, such activities, for which the good constitutes an input, are included as relevant factors. Similarly, Y

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[1] The analysis here pertains to markets in both Centrally Planned and Free Market Economies.

can be thought of as consumer income in final markets and as taxes or subsidies of the firm in intermediate markets.

For the set of commodities considered in the demand D - say good x and its subsitutes - P includes at least both official and actual (black market, or shadow market) prices for that good and its substitutes. By the same token, C includes the service levels associated with the same goods and prices, notably the actual wait times (queue lenths)[1] and other relevant qualitative service elements.

ii) **The Supply Actions Procedure** Sup

In any market, the second level of interest is that of the producers' behaviour. We use a **supply actions** procedure to explain the actions taken by suppliers of good x. As a general statement, these actions may determine a certain quantity S, scheduled service levels T (notably a scheduled queue or wait time) and a scheduled price F, called fare. These actions by suppliers are an outcome of their objectives O, their institutional environment E, their estimate of the state of the system ST and their resource costs. Resource costs are represented by a set of minimum cost combinations of resources $\{W(\tilde{S}, \tilde{T})\}$ that permit the realization of any scheduled quantity and service level pair $(\tilde{S}, \tilde{T})$ of output (we will use the brackets $\{\cdot\}$ to denote a set):

$$[S, T, F] \doteq \text{Sup}\,(O, E, \{W(\tilde{S}, \tilde{T})\}, ST)\ , \qquad (2)$$

where the state of the system is described by realized or estimated values of the demand $\bar{D}$, service levels $\bar{C}$, user unit costs $\bar{P}$ and effective or practical supply $\bar{Q}$ (to be defined shortly)

$$ST = (\bar{P}, \bar{C}, \bar{D}, \bar{Q})\ .$$

Suppliers' revenues depend on realized demands, fares and actual prices, and the fiscal-political part of the environment that determines the tax-subsidy rate structure.

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[1] More will be said below on wait time as a characteristic of supply.

The minimum cost quantity-service combinations can themselves result from a **cost minimization** procedure that considers feasible (and perhaps technically efficient) ways of combining available resources and their input prices in order to supply any scheduled quantity-service output [$\tilde{S}$, $\tilde{T}$]. The outcome of such a procedure need not be unique[1]. Nor do we imply that producers necessarily minimize costs. Indeed, in markets that are not perfectly competitive, producers may spend their "excess" profits on personal amenities, a quiet life, or other objectives defined in O and made possible by the nature of the competitive environment E. Clearly, a whole spectrum of behaviour arises as a function of that environment. In monopolistic markets, the supplier can take seperate decisions on quantity S, scheduled service T and fare F; a high degree of competition would reduce these degrees of freedom, set fares (or, alternatively, quantity-service combinations) and impose cost minimization as a condition of survival. The case of pure competition is a nested special case of (2). The regulated or quasi-monopolistic firms of CPEs are also included: typically, their quantities supplied S and their fares F might be regulated but they will respond by adjusting the service levels - notably the wait time or queue - to some desired or scheduled level T. Of course, they may, as a behavioural fact, actually react to prices actually paid by their clients $\bar{P}$, to actual service levels $\bar{C}$ and to quantities actually purchased $\bar{D}$ and modify the money, service level or quantity conditions of supply accordingly. In that sense, the queue can be "a non price signal which provides a positive signal to production" (see footnote p. 5).

But how are the realized or actual trades and their conditions determined? To answer this question correctly, we need to introduce, in a very general form again, the **performance** level.

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[1] For further details on **cost minimization** and underlying **production** procedures, see Florian and Gaudry (1983).

iii) **The Performance Procedure Per**

For given values of the supply actions [S, T, F] and demand D, a **performance** procedure yields market-clearing money and service conditions P and C, as well as effective or practical supply Q

$$[P, C, Q] \doteq \text{Per}\,(D, [S, T, F])\ . \qquad (3\text{-A})$$

Effective or practical supply Q was introduced in the original conceptual framework to handle goods supplied in chunky units (plane-loads of seats) or in units of theoretical capacity (bus-loads) and where actual behavior (for instance crowding) determined the actual capacity. The approach is in principle applicable to many chunky and nonstockable outputs, such as electricity generated by turbines that are either "on" or "off" but whose output per period will be lost if not used as produced. However, we lose no generality for our purposes by assuming that all output is consumed in the quantities in which it is produced and write

$$[P, C] \doteq \text{Per}\,(D, [S, T, F])\ . \qquad (3\text{-B})$$

The role of this procedure, which really fits "between" the first two, is to determine - in conjunction with the other two - quantities, service levels and prices that clear the market.

B. Equilibria and other properties

Consider the summary of the preceeding given in Figure 3. For simplicity, assume that wait time, or queue length, is the only service level of interest. Many equilibria can arise.

i) **Demand-Performance equilibria Dem-Per**

For given values of the supply [S, T, F], there are many ways in which an apparent disequilibrium can be eliminated. Assume that fares F are rigid and that, at that price, there would be excess demand D > S. In this case the actual queues C will adjust to clear the market - certainly

at a higher level that that of the scheduled queue T. Alternatively, a black market price vector[1] "could clear the market and C=T. More generally,

a demand-performance equilibrium Dem-Per is a set of prices and queues P ≷ F and C ≷ T such that D=S . (4)

If scheduled price and queueing values F and T imply excess demand and if prices will not clear the market, then realized queues C will clear the market. Similarly, were fares set too high, one would normally expect a shadow economy to generate equilibrating shadow prices and queues that are smaller that the scheduled ones.

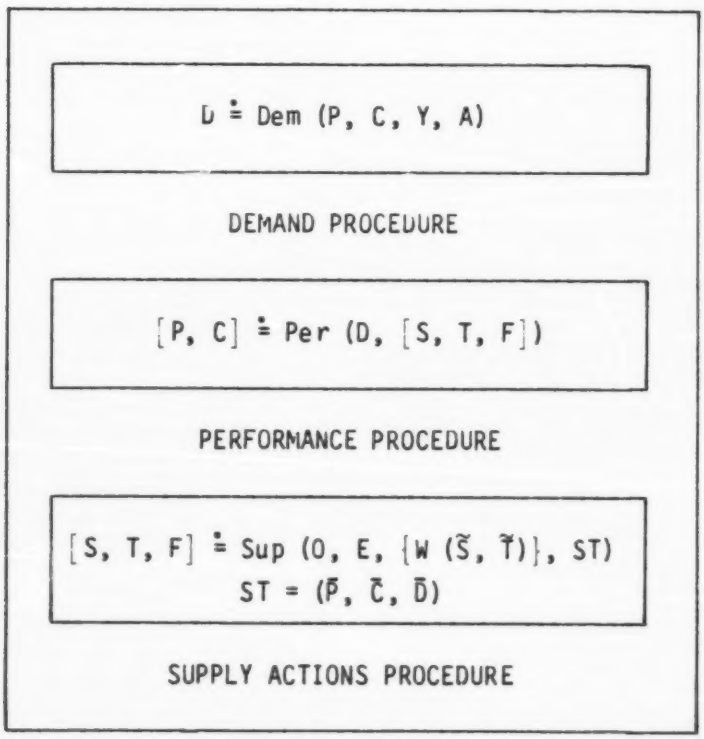

Figure 3: Market Analysis: a Three-Level Approach

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[1] It might have an official element equal to F and another element F* such that, with unchanged queues, the market will clear.

ii) **Demand-Performance-Supply equilibria** Dem-Per-Sup

A steady-state solution of the system shown in Figure 3 would be one in which the producers would have adjusted their output to the market values $\bar{P}$, $\bar{C}$ and $\bar{D}$ and would supply quantities under conditions consistent with those of the Dem-Per equilibrium. Each process would yield values consistent with those required in other processes in order to generate mutually determined values. Our solution is an equilibrium: it differs from the disequilibrium-with-delay recently proposed by Ducos (1985) because his delays do not reestablish equilibrium.

The benefits of our approach, which consists in making it clear how supply and demand are in effect brought into equality by the realized performance, include the practical advantage of avoiding the "short-rule" predicament that occurs if, with real observations assumed to represent potential disequilibria, one has to solve the combinatorial problem of deciding which of each observation is on the supply or demand curve[1]. One needs proper observations on actual prices and queues in order to **avoid mispecification of the demand function through the absence of the queue length variables.**[2] If one has observations on both of prices and queues that systematically underestimate or overestimate the time values, one can still obtain consistent parameter estimates in linear systems (except for the intercept term). As a modelling rule, the estimation of demand equations with variables for queues (time prices) is in principle always de rigueur (whether one has D=S or apparent excess supply or demand), lest one estimate misspecified equations.[3]

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1 The chronic shortage experienced in CPEs can of course lead to a simplification if the demand is never observed: only the supply is identified in simple permanent excess demand schemes!

2 For instance Kornai (1982, p. 139) computes a shortage index but Portes (1984) estimates macroeconomic demand functions without taking wait time into consideration.

3 Incorrectly accounting for queues can also occur in the formulation of supply or cost equations. Increased supply of doctors at fixed prices can give the impression that per capita hospital costs have increased when in reality the queues have simply shortened, without effect on unit costs.

Of course formally accounting for performance makes models more complex[1], but it emphasizes the importance of adjustments. The state of the system ST will also require much work for the analyst because the formal incorporation of political markets is often required to specify correctly the three levels and formulate a rich alternative to simplistic excess supply/demand schemes.

C. Some microeconomic foundations

Although the importance of queueing is known, and attempts have been made to incorporate it at the microeconomic level of demand behaviour (e.g. Greene, 1975; Kornai and Weibull, 1977), we have not found literature where the supply side is also accounted for, except perhaps in the area of the analysis of transportation monopolies that set fares and wait times so as to maximize a certain objective (e.g. Gaudry, 1973, Appendix 3). Yet the microeconomic analysis is relevant to underpin the aggregate behaviour described in our three-level system. We shall therefore initiate an analysis that makes the queue a central feature of both the demand and supply sides of the market; we will also suggest directions for further work. Our analysis will be **illustrative** and will not aim at obtaining exact results.

Assume that the firm's problem is to decide the set of {quantity-wait time} combinations[2] it is willing to supply per period t as a function of actual prices p_t and input prices w_t:

$$\{q, tw\}_t^s = s\ (p_t, w_t)\ . \qquad (5)$$

Our firm schedules a certain average wait-time or queue as part and parcel of its supply decision: this is clearly the case in free-market economies

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[1] An example of a complete three-level system of simultaneous equations is found in Gaudry (1980).

[2] It is essentially the same to use wait time or queue length to define the service level. Some readers might prefer to express (5) as $s^*\ (q_t, tw_t, p_t, w_t) = 0$.

for the overwhelming majority of markets for consumer durables and, to some extent, for many other goods as well; this means that a client can only get cars or computers that are not in stock by waiting, and this queue is the object of the firm's marketing decision. Given technology and input prices, the firm is willing to supply more at a given actual price only with longer wait times. This trade-off between quantity and wait time exists because of the randomness component of demand: being able to meet an uncertain demand as it occurred would require a combination of huge stocks and expensive continuous reorganization of production - as this demand has not only an expected value but a variance that can easily be large (and asymmetric) and consequently expensive to reduce. The firm's trade-off is shown in Figure 4. In part A, the firm's traditional short-run supply curve $S(tw_0)$ expresses the firm's willingness to supply more if the actual price increases and the wait time is given at tw_0; in part B another partial derivative of (5) is shown - at a given price p_0, the firm is willing to supply more units per period only at longer associated scheduled wait-times, as expressed by the curve $S(p_0)$.

Changing the ceteris paribus values naturally shifts these curves. If a higher wait time $tw_1 > tw_0$ is chosen, the firm is willing to supply more at any given price, along the $S(tw_1)$ schedule of part A. Similarly, were the price raised to $p_1 > p_0$, the firm would be willing to supply more at the same wait time, along the $S(p_1)$ schedule of part B.

The consumers' demand function for a period of time t can be written as a special case of (1):

$$q_t^d = d\,(p_t,\ tw_t,\ y_t)\ , \qquad (6)$$

---

[1] Here, in contrast with Kornai where higher queues increase the quantity supplied because it is "a signal to produce more", higher queues increase the quantity supplied because of the cost trade-off between quantity supplied and service quality.

where y_t simply denotes disposable income. One can see in part A of Figure 4 the consumers' traditional demand curve for a given wait time, $D(tw_0)$. Clearly, this curve shifts to the left if the wait time increases to tw_1: at the same price, consumers are willing to buy less - along the $D(tw_1)$ schedule. The other partial derivative of demand function (6) can be seen in part B where the schedule $D(p_0)$ expresses the fact that, at a given price p_0, consumers are willing to buy more units only if the wait time decreases. If the price increases to p_1, this schedule shifts to the left: at the higher price, consumers will reduce purchases along $D(p_1)$ if the wait times are unchanged.[1]

In Figure 4, the vector $[q_0, p_0, tw_0]$ is an equilibrium of the market characterized by $q^s = q^d = q_0$, free market price p_0 and free market wait time tw_0. One may ask what happens when regulation is imposed on the supplier. Assume for instance that price is regulated at $p_r < p_0$. This situation is illustrated in Figure 5. It might be thought at first that the queue will adjust in such a way as to shift the demand curve from $D(tw_0)$ to $D(tw_1)$ in order to wipe out the excess demand $q_1q_1^*$, and that one would move from E_0 to E_1. But that is not the case because, at the regulated price p_r, the supplier's offer of service shifts to $S(p_r)$ and the consumers' demand for service shifts to $D(p_r)$, both of which imply the higher new wait time tw_2. Unfortunately, this higher wait time will generally not shift the schedules of part A sufficiently to establish a market equilibrium: the point E_2 is likely to be inconsistent with p_r. For the market to clear, the wait time has to increase to tw_f, and at this point the demand schedule in part A of Figure 5 has shifted to $D(tw_f)$.

At that point the amount traded is q_f, the actual wait time is tw_f and the price is p_r. We note in part A of Figure 5 that, once account is

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[1] One could equivalently say that they will consume the same amount only if wait time falls.

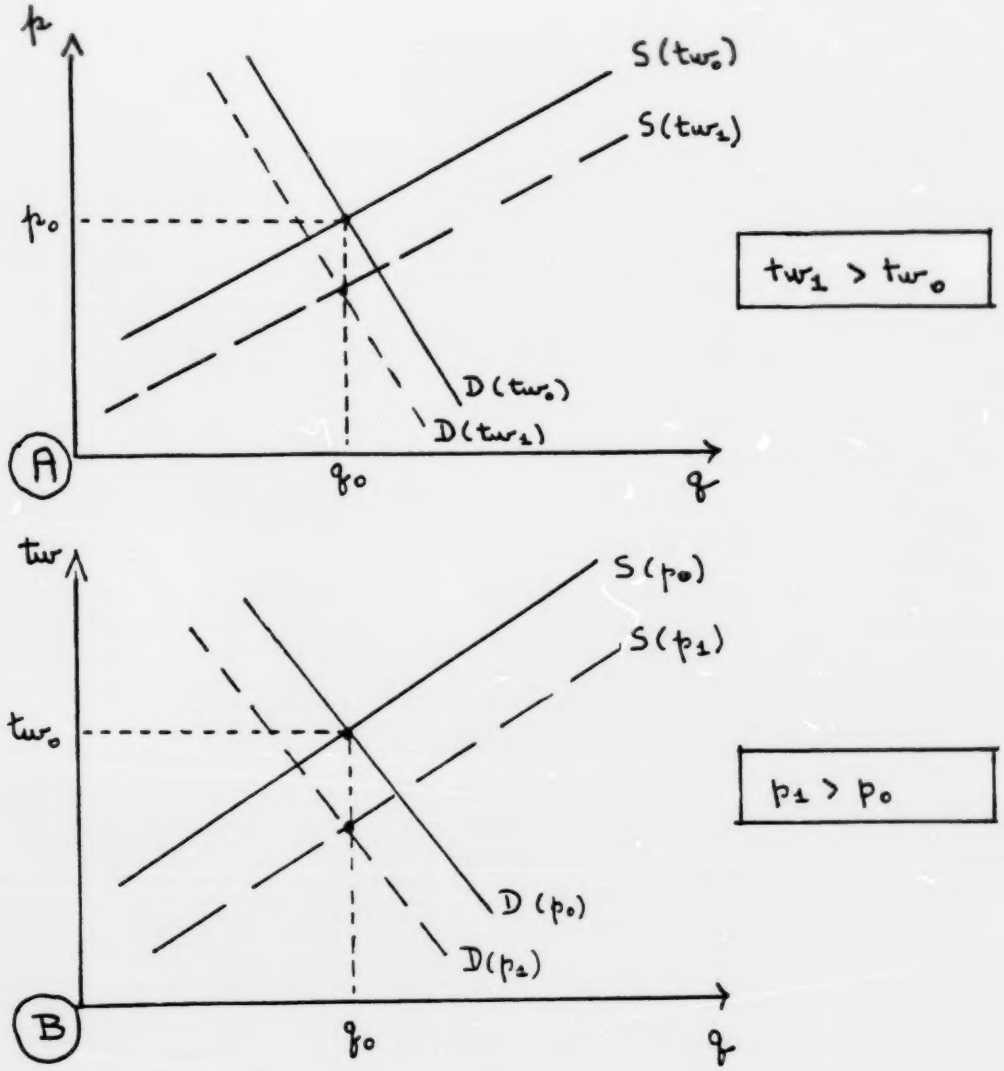

Figure 4: Two price-wait time Demand-Supply equilibria

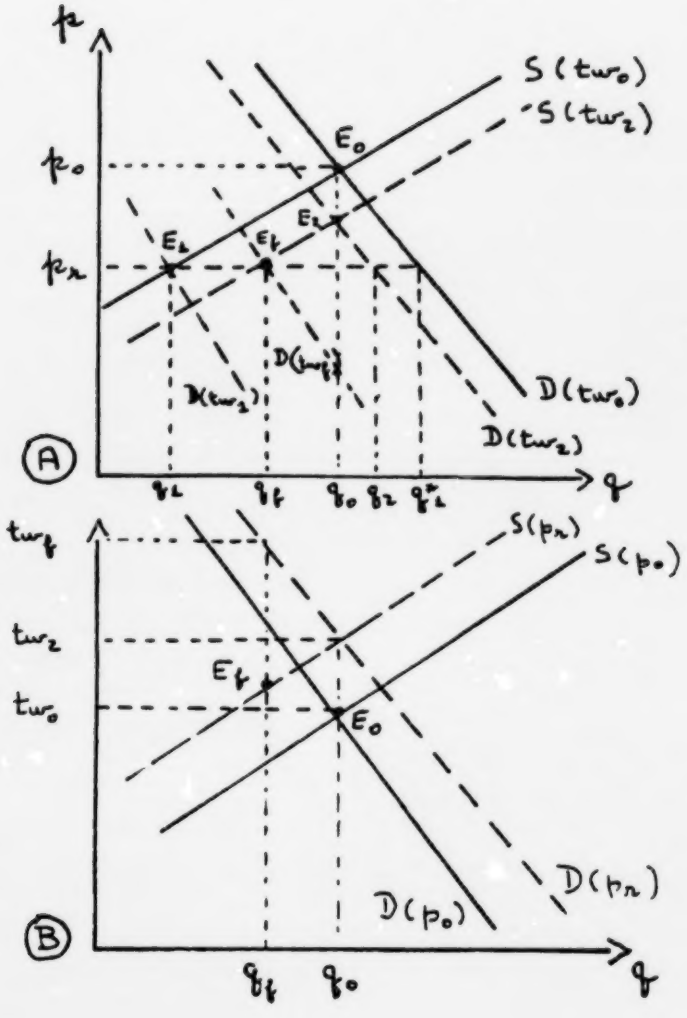

Figure 5: The effect of price regulation on quantity traded and wait time

taken of the shifts in the supply and demand for wait time caused by the regulated price $p_r < p_0$, excess demand first falls from $q_1q_1^*$ to q_fq_2 and that this excess demand is then wiped out by a lengthening of the queue from its scheduled level tw_2 to its market clearing level tw_f. We also note in part B that, because the firm is operating on its supply line $S(p_r)$ and producing only q_f, it has wasted productive capacity because, at the very high wait time tw_f, it would be willing to produce much more that q_f - indeed much more than q_0! - but effectively supplies at point E_f on $S(p_r)$ at an optimal **scheduled** wait time somewhat above tw_0 while the consumer effectively faces the actual wait time tw_f (about 60% more).

One could study with this simple model the effects of quantity regulation or of exogeneous shifts in demand or supply, or the possibility of multiple solutions, but we will leave this to another time as our purpose is simply to illustrate with a partial equilibrium example how regulation of the type found in CPE's (and also in the regulated sectors of free-market economies) can yield solutions in which realized queues reestablish the equality of Demand and Supply and at values different from both scheduled queues and free market equilibrium queues.

4. CONCLUSION

The important characteristics or our formulation are as follows:

- the real performance level depends not only on the available capacities, but also on demand. When demand increases, performance worsens: one has higher waiting times and money prices. But this may lead to short term supply actions such as squeezing more output out of existing capacities and to long term supply actions such as extending capacities;
- supply decisions pertain not only to quantities but to scheduled service levels and fares, and depend not only on input prices but also on performance levels;

- demand in turn depends on the levels of usual factors but also on the performance levels. For example, potential customers react to realized wait times that can in principle differ from scheduled wait times.

The extended equilibrium between S and D is obtained by changes in performance: in the case of the administered prices typical of the CPEs, this means changes in the time-prices. The queue equilibrates the market. We also have suggested that one should distinguish between the optimal free market queues and the queues that result from administered prices and may not be consistent with optimal use of resources.

As the whole system (1), (2), (3-B) is equilibrated through multiple adjustments of D, S, C, and P, this approach makes explicit the real performance level and stresses how it is determined simultaneously with other variables. We therefore provide an explanation of how a "normal" level of shortages comes into being, whereas in Kornai it is given and results from "historical reality".

Moreover, our approach has practical implications for the specification and estimation of econometric models: for instance, demand functions must include wait times as explanatory variables and performance functions must be specified explicitly, a task that permits the analyst to use equilibrium estimation techniques. Finally, our approach suggests[1] that the analysis of income distribution in CPEs should explicitly take into account the distribution of queuing time: consumers have variable amounts of disposable money income but identical amounts of available time that is effectively taxed by realized performance levels, with significant effects on their total "time and money" income.

Overall, the difficulty of going beyond the illustrative nature of our microeconomic analysis should not deter from further work to explore the nature of the underlying mechanism outlined only roughly here: only then will we know how really useful is the three-level approach to the modeling of planned markets.

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[1]This suggestion was made by Marcel Boyer.

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